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(56) Documents Cited

GB 2104558 A

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(54) Warp-knitted lymphoedema sleeve

(57) A lymphoedema sleeve is warp knitted with relatively inelastic base yarns (eg polyester) and laid-in elastic yarns. Size and resilience can vary along the length of the sleeve eg so as to taper from upper to lower arm and the relatively less dyeable elastic yarns can lie mainly on the inside. The lower end of the sleeve may be bifurcated to fit a wearer's digits. The sleeve may be knitted on a circular or a flat double-bed machine.

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Lymphoedema Sleeve

This invention relates to a lymphoedema sleeve. The sleeve is useful for engaging a limb, particularly an arm, which is susceptible to lymphoedema.

The sleeve has particular application in its use by patients who have had surgery which renders them susceptible to lymphoedema, in particular women who have undergone mastectomy. Lymphoedema sleeves for the arm can be made either as simple tubes to encase the arm from just below the shoulder to the wrist, or can contain a lower hand portion which can engage the thumb and the rest of the hands separately. In this second form of sleeve it is, of course, necessary for the sleeve to split in the manner of a glove. It is known to produce such sleeves by weft knitting. Weft knitting does allow the bifurcation to be achieved fairly easily, but the sleeve is fairly thick and bulky and can be uncomfortable and unsightly. Further, it is difficult using weft knitting to regulate the elastic qualities of the sleeve from end to end.

It is an object of the present, therefore, to provide a lymphoedema sleeve, and a method of making such a sleeve whereby the above described disadvantages can be reduced or minimised.

The present invention provides a lymphoedema sleeve produced by warp knitting, having relatively inelastic base yarns and laid-in elastic yarns.

The fabric can be made by warp knitting on a circular loom but is desirably made as a tubular fabric on a flat warp knitting loom.

To achieve a tubular fabric using a "flat" loom it is necessary that two needle beds be used. In the knitting of such a fabric on a two bed loom, two webs of base fabric can be knitted in different closely adjacent planes, the two fabrics being united at or adjacent the selfedges by the base yarns and/or the elastic yarns knitting between the two beds at the selfedges.

It can be desirable for the elastic yarns to be laid so as to have a major exposure on that side of the fabric which in use as a tube, is the internal face. The elastomeric yarn (which may be of rubber, plastics material or combinations of the two), having its major exposure on the internal face of the fabric enables the internal face of the fabric to maintain a good grip on a users skin so as to avoid creep and/or movement.

This also has a further advantage in that the elastic yarn (which in itself often cannot be adequately or desirably dyed or coloured) is essentially not exposed to view in use. This enables the base yarn to be coloured cream or light pink so as to match and/or simulate skin colour and to present a uniform external surface of such colour. This makes the sleeve much less noticeable than prior sleeves.

Further, by using warp knitting and laying in the elastic yarns it is possible to control very carefully the elastic properties of the sleeve. The base yarn used will probably be of polyester fibres. They do not degrade in use, they are compatible with use next to human skin and their properties are well known. By choice of base yarns of appropriate denier, and regulating the knitting, it can be assured that the tubular fabric is relatively inextensible in its longitudinal direction, its radial extensibility being determined (either completely or mainly) by the laid-in elastic yarns.

Elastic yarns cannot, of course, be fed from a reel or the like by negative tension, but a positive yarn feed must be provided to ensure that the tension in the elastic yarn remains within desired limits. Usually when creating an elastic fabric, it is important that the tension in the elastic yarns remains constant. However, when knitting a lymphoedema sleeve, there can be great advantages in varying the degree of radial extensibility over the

length of the sleeve. The extensibility (which can be referred to as the "hoop" elasticity) can be varied by controlling either the tension in the elastic yarn as fed to the knitting station, (for example by having a positive feed system) and/or by alternating other knitting characteristics during production of the tube. Thus, for example, a tube which is knitted so as to taper gradually from a position just below the shoulder to the wrist can have its hoop elasticity also varying from shoulder to wrist so as to ensure a firm grip all along the length and a uniform grip per area of skin all along the length of the sleeve. In the case of a sleeve adapted or useful for an arm, the tension in the elastic can be varied to take into account the size variation due to musculature in both the upper arm and the lower arm. This can ensure that only the minimum necessary gripping pressure is applied to the arm and that there are no unduly high or low tensions.

By knitting a flat fabric and uniting the two sheets at the edges, a tubular fabric is obtained in a particularly easy way. This method has other advantages. A sleeve may be required which has bifurcate so as to accommodate a thumb and the hand, that is to say a sleeve which has a first tube which extends perhaps as far as the first joint of the thumb and a second tube which extends for, or slightly beyond the first knuckles of the fingers. In extreme cases it may be necessary to create a device which applies pressure to the initial portions of all the

fingers adjacent the palm. In this case there can be four divisions of the tube so as to create, eventually, five individual tubes for embracing the proximal portions of the five digits.

The invention will be described further, by way of example, with reference to a specific embodiment thereof, it being understood that the following description is illustrative and not limited to the invention.

In the following, various details of the machine used and the method of the invention are described. It is to be understood, of course, that there are very wide possibilities for varying the criteria of the machine, the yarns used, and the knitting process, all of which will be apparent to those skilled in the art.

In carrying out a preferred method of the invention to create a preferred lymphoedema sleeve of the invention an 18 gauge double needle bed Raschel knitting machine is used. The machine has a double pattern drum and there are positive feed systems for controlling the let off of the elastic yarn and its feed to the knitting position.

The base yarn in the product is, in this particular instance, a polyester yarn. The yarn is not, intrinsically, completely

inelastic, but as it knits in the warp direction it produces a fabric which has only a small elasticity in the longitudinal direction. In the knitting the polyester yarns on the front needle bed produce, in combination with their yarn feeders a sheet of tricot composed of laterally extending stitches. The back bed produces a similar web. On an inner face of each knitted base web elastic fibres of LYCRA (R.T.M) are laid in to be exposed mainly on the inner face and to have their major extent transverse to the knitting direction to convey eventual loop elasticity but not axial elasticity. At the ends of the two beds, (the length of which can be appropriate to the eventual desired final diameter of the sleeve). The inelastic yarns knit between the two sheets so as to produce a circular fabric). The base yarn knits a generally one-by-one tricot sheet of fabric (two sheets) in side-by-side, face-to-face relationship. The elastic yarn is fed with a three needle underlap in opposition to each tricot underlap on the front and back faces. The elastic yarn is fed so that it lies, during production, primarily on the two internal faces of the two sheets of tricot fabric.

The base fibre of the product can be a polyester and the elastic fibres can be rubber and/or elastomeric and a mixture thereof making up a low percentage, perhaps 5 to 10, preferably 7, percent of the weight of the base fabric yarn. A preferred elastomer fibre is sold under the trade mark LYCRA (RTM) manufactured by Dupont. The elastomeric elastic fibres can be laid in so as to extend,

generally in a helical path. It is important, of course, that the lay of the elastic fibres is not such as to confer any significant longitudinal elastic property.

Similarly, it is important that the elastic fibres do not extend to a significant extent in a longitudinal direction without any tendency to extend in that direction being counteracted by a firm base fabric.

The sleeve is a 1 x 1 tricot warp-knitted tube @ 18 needles/inch of 150 den. dyed texturised polyester filament yarn. Further guide bars of 176dtex Lycra form a full-set three needle underlap alternative knitting at the selfedges. A control chain is designed to control the bifurcation, the independent speed of the take-down rollers (hence the graduation) and the speed of drive to the Lycra beam positive feed.

The current yarns and construction are chosen for ease of manufacture. Many other combinations could produce a viable sleeve. In particular the polyester yarn could be a chain stitch, a tulle net, a diamond net, short atlas and the Lycra could be a 2 or 4 needle underlap or a mixture of 2/3/4 needle underlaps.

A very important possible variation which can be made using the method of the invention is variation in hoop elasticity. Desirable variations along the length of the sleeve can be

accommodated and/or catered for. For example, in accordance with the shape of the arm and its general diameter it can be preferable for the forces to change at points along the sleeve, for example with greater forces being exerted in the wrist region than in the region of the upper arm. This "graduated" compression feature can be determined by adjustment of the tension of the elastic yarn at the knitting point, the yarn count (that is the amount of yarn per unit length of the sleeve and the number of courses per inch).

Further, by varying the base fabric, the shape of the sleeve (that is its width and/or diameter) can be varied along the length so that the taper of the sleeve varies. This can ensure that the sleeve flares outwardly towards the upper arm and applies generally uniform pressure along the full length of the arm, or applies pressure precisely where the designer wishes the pressure to be.

The invention is not limited to the foregoing, and variations can be made thereto.

For example, the nature of the various yarns used in the base fabric and the nature of the elastic yarns can be chosen at will to suit various applications and design characteristics. Elastic fibres made of rubber, elastics other than Lycra and combinations of elastomeric/rubber yarns can be used.

Instead of using a polyester yarn any other convenient and compatible yarn can be used.

Many other variations are possible.

Claims

1. A lymphoedema sleeve produced by warp knitting, having relatively inelastic base yarns and laid in elastic yarns.
2. A sleeve as claimed in claim 1 and made by warp knitting on a circular loom.
3. A sleeve as claimed in claim 1 and made as tube fabric on a flat warp knitting loom.
4. A sleeve as claimed in claim 3 wherein two needle beds have been used, two webs of base fabric having been knitted in different closely adjacent planes, the two fabrics being united at or adjacent the selfedges by the base yarns.
5. A sleeve as claimed in claim 3 wherein two webs of base fabric have been knitted in different closely adjacent planes, the two fabrics being united at or adjacent the selfedges by the elastic yarns laid in between the two beds at the selfedges.
6. A sleeve as claimed in any preceding claim wherein the elastic yarns have been laid so as to have a major exposure on that side of the fabric which, in use as a tube is the internal face.

7. A sleeve as claimed in claim 6 wherein the base yarns have a major exposure on the external face of the fabric and are of relatively easily dyable yarn.
8. A sleeve as claimed in any preceding claim wherein the sleeve is tapered so as to closely fit a human limb, tension in the elastic yarns being controlled throughout so that the hoop elasticity varies in accordance with the sleeve taper.
9. A sleeve as claimed in claim 8 wherein the hoop elasticity is varied to ensure that only a minimum necessary gripping pressure is applied to the limb without unduly high or low tension points.
10. A sleeve as claimed in any preceding claim and being bifurcate so as to accommodate separately a users digit(s).
11. A sleeve as claimed in any preceding claim wherein the base yarn, as it knits in the warp direction produces a fabric having only a slight elasticity in the longitudinal direction.
12. A sleeve as claimed in any preceding claim wherein the elastic yarns are laid in a generally helical arrangement along the length of the sleeve.

13. A method of making a lymphoedema by warp knitting relatively in-elastic base yarns and laying in elastic yarns.
14. A method as claimed in claim 13, and carried out on a circular loom.
15. A method as claimed in claim 13 and carried out on a flat warp knitting loom.
16. A method as claimed in claim 15 wherein two needle beds are used, two webs of base fabric being knitted in different closely adjacent planes and, the two fabrics being united at or adjacent the selfedges by the base yarns.
17. A method as claimed in 16 wherein two webs of base fabric are knitted in different closely adjacent planes, the two fabrics being united at or adjacent the selfedges by the elastic yarns knitting between the two beds at the selfedges.
18. A method as claimed in any preceding claim wherein the elastic yarns are laid so as to have a major exposure of that side of the fabric which, in use as a tube is the internal face.

19. A method as claimed in claim 8 wherein base yarns have a major exposure on the external face of the fabric and are of relatively easy yarn.
20. A method as claimed in any preceding claim wherein the sleeve is tapered so as to closely fit a human limb, tension in the elastic yarns being controlled so that the hoop elasticity varies in accordance with the sleeve taper.
21. A method as claimed in claim 20 wherein the hoop elasticity is varied to ensure that only a minimum necessary gripping pressure is applied to a limb without unduly high or low tension points.
22. A method as claimed in any preceding claim including causing the sleeve to at least bifurcate so as to accommodate a users digit(s).
23. A method as claimed in any preceding claim wherein the base yarn, as it knits in the warp direction produces a fabric having only a slight elasticity in the longitudinal direction.
24. A method as claimed in any preceding claim wherein the elastic yarns are laid in a generally helical arrangement.
25. A lymphoedema sleeve made by the method of any of claims 13 to 24.

26. A lymphoedema sleeve substantially as herein before described.

**Examiner's report to the Comptroller under Section 17
The Search report)**

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Relevant Technical Fields

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(ii) Int Cl (Ed.5) A61F; D04B

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Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-

(ii) **ONLINE DATABASES: WPI**

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2104558 A (MOLINIER) See whole document	1, 2, 13, 14, 25
X,Y	GB 1378426 (ROUSSEL) See whole document	X: 1, 3, 4, 8, 9, 13, 15, 16, 20, 21, 25 Y: 12, 24
Y	GB 1368927 (LEVIN) See eg. Figures 1, 2	12, 24
X,Y	GB 1282608 (KLATTE) See whole document	X: 1, 3, 4, 8, 9, 13, 15, 16, 20, 21, 25 Y: 12, 24
Y	US 4469095 (HERRERA) See whole document	1, 2, 13, 14, 25
X	US 4240160 (IMBODEN) See whole document, especially column 4 lines 22-36	1, 8, 13, 20, 25

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).